

May 1, 2000

**GMP # 105**

To: District Environmental Health Managers  
District Health Directors  
OEHS Field Staff

Through: Donald J. Alexander, Director  
Division of Onsite Sewage and Water Services

From: Anish R. Jantrania, Ph.D., P.E.  
Technical Services Engineer

Subject: Experimental Protocol for Aquarobic Filter Bed System on Sloping Sites  
with Fill Material

The Department has completed a review of the Aquarobic Filter Bed system installation on sloping sites using fill material. This GMP is similar to GMP # 85 and is intended to provide guidance on how to process applications for the Aquarobic Filter Bed Systems on sloping sites. The approval granted in GMP #85 does not address sloping sites and the use of fill material. The purpose of this GMP is to incorporate a methodology for dealing with sloping sites with the prior approval for the filter bed. The site criteria are contained in the Experimental Protocol document. The concepts contained in GMP #85 are incorporated in this document and therefore GMP #85 is rescinded concurrent with the issuance of this document.

This protocol is intended to allow demonstration of the Aquarobic Mini-Plant Filter Bed System with or without fill material. The purpose is to determine whether the system can overcome soil and site limitations that would prohibit the use of a conventional septic system where percolation rates exceed 120 MPI, or the required stand-off distance to water table cannot be met, or both.

Aquarobic International Inc. applied for a variance from §12 VAC 5-610-370.A.2 of the *Sewage Handling and Disposal Regulations* for GMP #85. The request for the variance was approved on February 14, 1997 and the backup requirements have been modified. In essence, a 100% repair area meeting the same site and size requirements of the original Aquarobic Mini-Plant and Filter Bed System will be an acceptable backup

for the sites that do not meet the requirements for a conventional system. The same approval will be used for this GMP. Please refer to the variance that describes the backup requirements and the justification for granting this variance and required conditions of the variance.

The Department's approval of this protocol is granted only for The Aquarobic Mini-Plant and Filter Bed System and is not transferable to any other product. Applications for products other than Aquarobic Mini-Plant and Filter Bed System, or for sites that exceed the scope of this waiver, are subject to the provisions of §12 VAC 5-610-370.

The process to obtain a construction permit for Aquarobic Mini-Plant and Filter Bed System begins with filing an application. Applications may be made to review a new site, to modify a previously issued permit, or to convert a 415-certification letter to a construction permit to allow an Aquarobic Filter Bed System. Please note that experimental systems cannot be converted to an approval letter and that experimental construction permits cannot be valid beyond the completion of the experiment. All permits issued under this protocol must be recorded with a copy of the variance in the same manner that conditional permits are recorded. Please refer to Section IX-E of the protocol that addresses some practical matters related to experimental permits.

The waiver defines the Aquarobic Filter Bed System on sloping site with fill material as an experimental system. Mr. Daniel E. Pavon, the President of the company prepared the experimental protocol submitted by Aquarobic, and all testing associated with the protocol will be conducted under the auspices of a professional engineer. Local health departments may, at their discretion, require either formal or informal plans and specifications, as deemed appropriate for the proposed use and site conditions, prior to issuing a permit. All provisions of §12 VAC 5-610-370 except the requirements for a backup site apply when issuing a permit. A backup site meeting the requirements of February 14, 1997 variance is required prior to permitting any site. Individual permits shall be issued by the local health department and a copy of the permit and site conditions sent to the Division of Onsite Sewage and Water Services.

When a new application is made for a construction permit and it specifically requests an Aquarobic Filter Bed System, an application fee shall be charged and the site shall be evaluated in the same manner as any application for a conventional septic system except that the site and soil conditions contained in the Experimental Protocol may be used. If the site and soil conditions meet these criteria, the site shall be deemed suitable for an Aquarobic Filter Bed System.

Applications to convert a 415-certification letter to an Aquarobic Filter Bed system, shall follow the same general process, including collecting a fee; however, no soil evaluation is specifically required. A site evaluation (as opposed to soil evaluation) may be necessary to assure that conditions have not substantially changed since the letter was issued. If the site and soil conditions are unchanged and meet, the criteria contained

in the Experimental Protocol the site shall be deemed suitable for an Aquarobic Filter Bed system.

When an application is made to convert an existing Type I or II permit to an Aquarobic Filter Bed system, no application fee shall be charged, as no site evaluation should be necessary. If the documented site and soil conditions indicate the site meets the criteria in the Experimental Protocol, the site shall be deemed suitable for an Aquarobic Filter Bed system.

System design, installation, and operation shall comply with the requirements described in the Experimental Protocol, Aquarobic design, construction and installation literature, the *Sewage Handling and Disposal Regulations* and standard engineering practices.

Attachments:

Aquarobic Filter Bed System on Sloping Sites with Fill Material – Experimental Protocol

## Condition of Approval

### Aquarobic Filter Bed System<sup>1</sup> on Level and Sloping Sites with Fill Material – Experimental Protocol

This GMP is similar to GMP #85 and is intended to clarify the use of fill material under the entire area of the filter bed to maintain a level area for the 12” of imported sand layer (See Figure 1). The Filter Bed approval granted by GMP #85 does not address sloping sites and the use of fill material. The purpose of this policy is to address both of these issues. GMP #85 is hereby rescinded concurrent with the issuance of this policy.

All portions of the Aquarobic Filter Bed System shall be designed to provide wastewater treatment and disposal equal to or better than a conventional gravity drain field system. Aquarobic International Inc. will prepare a site-specific design for every installation that is considered under this GMP. It is the intent of this policy to allow Aquarobic the opportunity to demonstrate that the Aquarobic Filter Bed provides wastewater treatment and adequate subsurface disposal to render the wastewater harmless to the public and the environment.

#### I. Scope of Waiver

This waiver is granted for facilities generating wastewater flows of 1,200 GPD or less and of residential strength (BOD<sub>5</sub> and TSS <400 mg/l). Larger flows may be permitted but shall be reviewed individually to assure compliance with the requirements of §12 VAC 5-610-370 of *Sewage Handling and Disposal Regulations*.

An initial waiver is granted for the construction and operation of up to 100 systems. This waiver may be extended up to a maximum of 500 systems based on the observed and measured performance of the Aquarobic Filter Bed. Of these, at least 24 systems (recommended by Aquarobic and approved by the Department based on their location and use) will be monitored for treated effluent quality and the potential ground water contamination. Of the 24 systems not less than 10 sites selected will have systems constructed with fill and not less than 10 sites will have systems constructed without fill. It is the intent of this policy to monitor and evaluate approximately equal numbers of both types of systems. Systems currently monitored under GMP #85 shall qualify as systems monitored under the policy. At least 50% of the systems installed will be monitored for site conditions on and around the Filter Bed. The testing protocol is described in Section VII.

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<sup>1</sup> The Aquarobic International, Inc. Proprietary Mini-Plant<sup>™</sup> and Filter Bed disposal system under this GMP (Figure 1) is sold and warranted as a package system. The system design and concept, including the Mini-Plant and the Filter Bed, herein disclosed is proprietary with Aquarobic International Inc. and may not be reproduced or used with any other aerobic or septic tank system without prior written authorization from the Aquarobic International Inc. This is not intended to mean that this GMP or any drawings or description of the systems presented in this GMP can not be photocopied or reproduced by other means for the purposes of information dissemination.

## **II. System Description and Operation**

The Aquarobic Mini-Plant and Filter Bed System consists of a treatment device (The Mini-Plant™) and a specially design Raised Filter Bed. This experimental protocol is based on the specific components and design supplied by Aquarobic International Inc. (540-635-5200). Unless otherwise stated, the components of the Aquarobic Mini-Plant and Filter Bed for sloping site system shall comply with the intent, objectives, and requirements of the *Sewage Handling and Disposal Regulations*.

The Mini-Plant™ is an advanced wastewater treatment system to treat domestic wastewater (BOD<sub>5</sub> and TSS ranging from 100 to 400 mg/l) from residential and commercial units. The Mini-Plant treatment system is available in a custom manufactured Fiberglass tank or as an add-on kit to be installed onto a locally manufactured one compartment concrete tank(s). Table 1 lists Mini-Plants to be used under this GMP.

The Mini-Plant's one compartment tank (Figure 2) is sized to hold a minimum of 3 times the daily expected flow and the air compressor is sized to provide a minimum of 2,100 cubic feet of air per day per pound of BOD<sub>5</sub>. The system works on a periodic fill and draw principle (Sequencing Batch Reactor) wastewater is continuously exposed to fine bubble diffused air. At 2 AM the blower stops, and a quiescent settling period of 3 hours follows. At 5 AM a one hour decant period starts and the suspended pump discharges the treated effluent into the raised filter bed disposal system. The programmable control system is available to change the settings for any of the three periods to match the daily water use pattern.

The Mini-Plant tank must hold at a minimum (3) three times the maximum daily designed wastewater flow for domestic use and (4) four times the maximum daily design wastewater flow for commercial use. Several high density air diffusers and one industrial type stainless steel submersible pump is installed inside the tank. The tank also contains three liquid level sensors, float switches:

- FLS # 1 - low level pump shut off
- FLS # 2 - high liquid level alarm and blower shut off
- FLS # 3 - emergency pump on liquid level switch

Under normal operation, the low level pump shut off switch (FLS #1) turns the pump off once the daily amount of treated effluent is discharged into the filter bed. The high liquid level alarm (FLS # 2) turns on when the tank is 2/3 full, there is 1/3 capacity left in tank or a one day capacity, this switch turns on the alarm light, buzzer, the remote alarm, and turns off the air compressor. In an event that the liquid reaches the emergency pump on switch, (FLS # 3), the control panel will turn on the pump to prevent flooding of the compressor. By the time this event takes place, the liquid in the Mini-Plant would have been perfectly quiescent for some time as the blower was turned off by FLS #2. So, only clear supernatant is pumped to the filter bed. The pump would then run until the

level is down to the high water alarm switch thus preventing the blower and other electrical components from flooding.

Aquarobic USA claims the Filter Bed system operates by receiving highly treated wastewater from the Mini-Plant (reported effluent concentrations - 7 mg/l BOD<sub>5</sub>, 11 mg/l SS and 5 mg/l DO) to function under the conditions described in this GMP. The effluent is expected to move by capillary or wicking action of the 12" of sharp mason sand material on the contact and mantel area. The removal and reuse of the effluent from the filter bed is enhanced by photosynthesis of Kentucky 31 Tall Fescue grass with its broad leaf and very long root system (more than 18"). Other water loving plants (evergreens, willow trees etc.) planted on the mantel area will take up additional water. The root systems of these plants help to aerate the soil and increase the capillary or wicking action. This creates a man-made environment to recycle the effluent. The system reportedly improves with age as the vegetation becomes more established.

It is therefore essential that a health crop of Kentucky 31 Tall Fescue be maintained over the filter bed. During late fall or early spring, sod may not be available. When sod is not available, or at the contractor's preference, the Filter Bed may be seeded and covered with a soil retention cloth material or Hydro-seeded to keep the soil from eroding until sod becomes available or until the Kentucky 31 Tall Fescue grass is established. The mantle area must be crowned and seeded using Kentucky 31 Tall Fescue grass.

### III. Siting Criteria.

The Aquarobic Filter Bed System may be used to provide wastewater treatment and disposal at any site that meets one of the following criteria:

1. Any site that fully complies with the criteria contained in the *Sewage Handling and Disposal Regulations*, including but not limited to absorption area sizing, percolation rate, landscape position, stand-off distances, and set-back distances.
2. Any site that does not comply with the minimum stand-off to limiting conditions (rock and/or water table) requirements or the percolation rate requirements contained in the *Sewage Handling and Disposal Regulations* but does comply with the requirements of Figure 4 (page 15). Note: In accordance with a variance issued on February 5, 1997, these 100 systems require an available repair area equal to 100% of the original Aquarobic Mini-Plant and Filter Bed System area (see variance letter for complete details). Systems meeting these criteria shall be sized in accordance with Aquarobic Filter Bed sizing criteria contained in Table 2 and in Section I.
3. Any repair permit that complies with §12 VAC 5-610-280.C.2, where the Aquarobic Filter Bed system is used potentially to enhance treatment and disposal.

4. Any site that has a construction permit issued under the *Alternative Discharging Regulations* and has a site that complies with the requirements of Figure 4. The surface water discharge permit can be used as a backup system. Note that the Aquarobic Mini-Plant is approved for discharging system (GMP#68).

The current stand-off distances to rock and water table for conventional septic systems are proposed for revision. These revisions may affect the standoff distance for this system. If the proposed revisions are adopted as drafted, the standoff distance for the Aquarobic Filter Bed system may be revised to 12 inches in all soil types.

#### IV. Design Criteria.

The Mini-Plant shall be selected from the models listed in Table 1 based on the design flow rate. The Mini-Plant one compartment tank (Figure 2) is sized to hold 3 times the daily expected flow and the air compressor is sized to provide a minimum of 2,100 cubic feet of air per day per pound of BOD<sub>5</sub>. Aquarobic International Inc. will supply the necessary control panel and in-tank components for each installation.

The Filter-Bed disposal system will be designed based on soil and site conditions. All material used for constructing the filter bed shall be approved by Aquarobic International Inc. and the specification will be indicated on the final drawing. The size of the Filter Bed for design flows up to 1,000 GPD and percolation rates less than 250 MPI is presented in Table 2.

The treated effluent from the Mini-Plant is dosed into the raised filter portion of the Filter Bed disposal system every day in a one-hour period. Typically, from 5 AM to 6 AM, treated effluent is dosed to a distribution grid (4" perforated pipe). The grid is placed level, on 15" centers, in 12" of ½" to ¾" size stone (meeting the physical criteria for stone contained 12 VAC 5-610-930.E.6.a, except for size) on top of the 30" of filter material (Figure 3). The side slope of the filter bed must be on a 3:1 or greater except where the fiberglass filter media box is used. The top surface of the filter bed is designed using a loading rate of:

- 4 GPD/Sq. Ft. for residential systems with flows up to 1,000 GPD, and
- 2.5 GPD/Sq. Ft. for commercial systems of any size and residential systems with flows greater than 1,000 GPD.

The maximum size of the top surface of any filter bed must not be more than 900 Sq.Ft. When a larger area is needed, multiple beds will be used and the beds must be separated by minimum distance of 15' on a common base area, also known as contact and mantle area. The filter media, sand, and fill material used in the filter bed system must be approved by the Aquarobic International Inc. Form-1 (copy attached) must be completed for each system installed under this GMP.

Typical filter media has -



- an effective size of 1.0 to 10.0 mm,
- uniformity coefficient less than 5.0, and
- fine content less than 0.5 percent.

The contact and mantle area, make the total area for the Aquarobic Filter Bed System. The total area is determined based on the estimated or measured percolation rate of the soil material present in the 12" immediately below the bottom of the filter bed (see Table 2). When sufficient depth exists between the ground surface and the limiting zone (gray mottles and/or bedrock) the total area may be cut into the ground to a depth that will leave the required separation to the limiting zone as shown in Figure 4. However, if the site has limiting zone at 12" from the ground surface, the bottom of the entire filter bed will be placed at the ground level or in area that is leveled with fill material on sloping sites. The use of fill material under the filter bed to maintain a level contact and mantel area for the 12" of the imported sand layer, is part of the total design of the Aquarobic International, Inc. filter bed system (See Figure 1). After the total area has been leveled with fill material it will be back-filled with 12" of Aquarobic approve sand. Then thirty inches of clean filter material (clean stone as previously described) is placed on top of the sand at one end (See Figure 1).

The contact and mantle area is the total area of the filter bed system and it shall be sized according to Table 2.

The contact and mantle area (A) is sized using the formula:  $A = QT/25$  where -

- A = area in Sq.Ft.
- Q = design flow in GPD
- T = percolation rate of the top 12" of soil material from ground surface measured in MPI.

Regardless of the formula, the loading rate to the filter bed system for sites with percolation rate greater than 250 MPI will not exceed 0.10 GPD/ Sq. Ft.

At a minimum, the contact and mantle area shall be at least as wide as the foot print of the filter bed and extend from the outer distribution pipes in the direction of flow. All other horizontal separation distances (for example, well, property line, building, and others) shall be measured from the filter bed toe as shown in Figure 1.

Whenever possible the contact area is to be cut into the ground (level  $\pm 1$ " ), and back-filled with a minimum of 12" of Aquarobic approve sand. On sites with slopes and only 12" separation to the limiting zone, no cutting will be done, and it may be necessary to import fill material to prepare level contact and mantel area. The fill material shall be from texture group 3 or 4 as approved by Aquarobic in writing. Since no cut shall be made on such sites, the 12" separation distance in the original soil will be maintained under the fill material and sand bed. Adequate measures will be taken as proposed by Aquarobic International, Inc., to prevent any breakout of effluent along the downhill side of the system.



When a water table or bedrock occurs 12 inches from the ground level, the system will be placed at grade on flat ground. On sloping sites, a berm of clay material or Bentonite around the perimeter of the contact and mantle area must be constructed and have a minimum of 3 to 1 side slope (See Figure 1). Once the berm is in place, 12" of 0.5 to 1.5 mm clean sharp sand for the mantle and contact area is installed.

After the 12" of level sand bed is created, 30" of filter media and its 3:1 sides slope are constructed at one end of the sand bed creating the footprint of the filter bed. As previously noted, the 3:1 side slope requirement does not apply when the design incorporates a fiberglass filter media box. The distribution piping is placed in a 12" layer of gravel (½" to ¾" size) above the 30" of filter media and covered by 6" to 8" of topsoil over the mound. 1" to 2" of topsoil (approved by Aquarobic International, Inc.) is placed over the entire mantel area.

All material used for the construction of the filter bed will be approved by and the Form-1 (a copy attached) will be completed by Aquarobic International, Inc. for every system installed under this GMP.

#### V. Installation

1. Installers shall be trained by Aquarobic International Inc. or its representative, and be certified as having passed their minimum training qualifications prior to installing any systems in Virginia.
2. The manufacturer's recommendations shall be followed for system startup.
3. All mechanical components must be demonstrated to be operational in accordance with their design.
4. Aquarobic shall certify in writing that the system was installed in accordance with the plans and specifications relied upon for the issuance of the construction permit. When minor deviations from the permit have occurred, which do not alter the location or operation of the system, Aquarobic shall note the deviations and provide the Department with 'as built' revisions at the time they certify the system. Substantive changes, as determined by the Department, shall be brought into compliance with the *Regulations* and this policy

#### VI. Operation

All system owners shall be provided with written and oral instruction on the proper operation and maintenance of the Aquarobic Filter-Bed system. At a minimum, this will include a copy of the Homeowner's Manual prepared by Aquarobic International Inc. Updates, revisions and other changes to this section are the responsibility of Aquarobic International Inc. Copies of changes should be submitted to the Department on an informational basis and must be distributed to all the customers.

Nothing in this approval is intended to prevent or restrict the development of instructional materials for public use. No prior approval of such literature is required provided the literature contains no endorsements, approvals, or suggestions that the Department in any manner promotes the use of one system above any other.

## VII. Testing and Evaluation Procedures

The purpose of the testing and evaluation procedures is to determine strengths and limitations of the Aquarobic Filter Bed System when designed for use in the receiving environments described in this policy.

Testing of the Aquarobic Mini-Plant and Filter Bed with fill material will be conducted at three levels.

- Level 1 testing will include "basic" observation of at least 50% of the installations randomly selected by the Department or Aquarobic International Inc. during the first year of operation to determine site conditions on and around the treatment unit and the filter bed system. The primary objective for this testing is to determine if there are any operational problems such as odor with a treatment unit or problems such as ponding or breakout with a filter bed. Field observations will be recorded on Form-2 (a copy attached).
- Level 2 testing will include sampling and analysis of the ground water samples collected from the far end of the mantle area. At a minimum, 12 installations will be used for the Level 2 testing. Aquarobic International Inc. will install 4" PVC test pipes at the selected installations. The test pipes will be installed between the Mini-Plant™ and the Filter Bed, and at the far end of the mantle area. The objectives for this testing are to determine the effluent quality of the Mini-Plant™ and the quality of the water leaving the filter bed disposal system. Effluent samples will be collected quarterly for one year and the results will be recorded on Form-3 (a copy attached). Flow data will be monitored to determine the amount of wastewater (G.P.D.) treated. A complete soil and site evaluation will be performed and recorded prior to installing the systems to be monitored for Level 2 testing.

Under the Level 2 testing, Aquarobic International Inc. has proposed and the Department has agreed to test the Mini-Plant™ effluent from 12 sites on a monthly basis for a period of 18 months for the following parameters:

1. pH, temperature, conductivity, chloride (system's performance indicator parameters),
2. BOD<sub>5</sub>, TSS (organic strength indicators),
3. ammonia-nitrogen, nitrate & nitrite-nitrogen, total kjeldahl nitrogen, total phosphorus (nutrient indicators), and

4. fecal coliform (bacteriological indicator)
- Level 3 testing will include sampling and analysis of the treated effluent as it moves through the filter bed disposal system. At least 4 sites with different flow conditions will be selected for the level 3 testing. Effluent samples will be collected from a depth of 12", 18", 24", and 30" below the elevation of the distribution grid as well as from 12" below the original ground level. Ground water monitoring ports will also be installed at these sites to determine ground water elevations and background water quality. Sites that are selected for the level 2 testing may also be used for the level 3 testing. The primary objective of this testing is to determine the quality of Mini-Plant<sup>TM</sup> effluent as it travels through the filter bed and to evaluate the need for stand-off distance in the "A" horizon. Effluent samples will be collected monthly for 18 months and the results will be recorded in the Form-3 (a copy attached). Flow data will be monitored to determine the amount of wastewater (GPD) treated.

This list of parameters may expand if the Department deems them necessary to establish treatment efficacy. The ground water samples and the effluent samples in the filter bed will be analyzed primarily for nutrient and bacteriological parameters. An increase in chloride concentration must be observed to indicate the presence of treated effluent in the ground water samples.

All sampling and the submission of reports shall be done by or under the supervision of a professional engineer registered in Virginia. All testing and the submission of results shall be the exclusive responsibility of Aquarobic International, Inc. In the event that interim test results preclude the possibility of the product passing the experimental protocol, the Department may notify Aquarobic by certified mail that additional testing is not warranted. Failure to submit results on time is considered to be a sufficient basis to discontinue this experimental protocol. Prior to taking such action the Department shall provide Aquarobic International, Inc. 30 days written notice of its intention to discontinue the protocol and include in the notice opportunities to challenge the decision as may be provided under the Administrative Process Act.

#### Standards

The following standards will be used to monitor and evaluate the performance of the Aquarobic Filter Bed system.

- **pH, Conductivity, Temperature, and Dissolved Oxygen:** These parameters will be monitored as indicator parameters only. There are no set absolute standards for these parameters.
- **BOD<sub>5</sub> and TSS:** BOD<sub>5</sub> of the Mini-Plant<sup>TM</sup> mix liquor samples must not be less than 100 mg/l and more than 10,000 for any individual samples and average less than 7,600 mg/l over the sampling period to verify that a typical strength residential waste is being treated.
- Effluent from the Mini-Plant<sup>TM</sup> will be tested to demonstrate treatment effectiveness. BOD<sub>5</sub> of the individual samples must not exceed 20 mg/l and average less than 10

mg/l, and TSS of the individual samples must not exceed 30 mg/l and average less than 15 mg/l.

- **Chloride:** This is an indicator parameter only and will be used to determine presence of the effluent leaving the raised filter in the ground water monitoring wells. There is no absolute standard for this parameter.
- **Ammonia-N, Total Kjeldahl-N, Nitrate and Nitrite-N:** These parameters will be monitored to determine total nitrogen in the treatment plant effluent and in the ground water. There are no absolute standards for different forms of nitrogen and the total nitrogen in the treated effluent. However, the average total nitrogen in the effluent sample from the far end of the mantle area must be less than 10 mg/l. Note: This standard may be adjusted to correspond with research results on conventional septic tank drain field system technology with 18" stand-off in texture group II, III, and IV soils.
- **Total Phosphorus:** There is no absolute standard for Total-Phosphorus in the treated effluent. However, the average total phosphorus in the effluent sample from the far end of the mantle area must be less than 1 mg/l. [Note: This standard may be adjusted to correspond with research results on conventional septic tank drain field system technology with 18" stand-off in texture group II, III, and IV soils.]
- **Fecal Coliform:** The average of samples collected from far end of the mantle area shall average less than 10 cfu/100mls and have no single sample in excess 200 cfu/100mls. Sample results obtained during the first six months of operation may be discarded from the performance evaluation at the sole discretion of the Department, when there appears to be due cause. [Note: This standard may be adjusted to correspond with research results on conventional septic tank drain field system technology with 18" stand-off in texture group II, III, and IV soils.]
- **Surfacing and Ponding:** Any system that shows surfacing of effluent (fecal coliform from human source > 20 cfu/100ml) shall be considered a failure. An evaluation shall be made of the system to determine the cause of failure, and corrective action shall be taken.

#### VIII. Operation and monitoring.

For the first three years of use after this experimental protocol is granted, Aquarobic International Inc. shall maintain a log of all systems installed. The log shall include the following minimum information:

1. System location (by tax map or owner's name and county),
2. Soil conditions where the system was installed,
3. All associated physical, biological and chemical data if the system is one being monitored.

The log shall be reported to VDH-OEHS Technical Services Engineer on a quarterly basis and shall be provided by the 15th of the month following the end of the quarter. The log shall be available within 5 business days upon request.

IX. Responsibilities and permitting procedures.

- A. This approval has been granted specifically for the process described in the application made by Aquarobic International Inc. for the Aquarobic Filter Bed system. Any changes to the components used in this process must be reviewed and approved by VDH-OEHS Technical Services Engineer on a case-by-case basis prior to use.
- B. No contractor may install an Aquarobic Filter Bed system unless they are first certified by Aquarobic International Inc, as meeting their minimum competency standards for contractors.
- C. The Aquarobic Filter Bed system is an experimental system; however for the purposes of permitting, it shall be handled in the same manner as a Type II system.
- D. Permitting shall be done by the local health departments based on their satisfactory site evaluation and review of drawings and specifications prepared in accordance with the manufacturer's specifications, all applicable state regulations and policies, and any relevant local ordinances.
- E. Construction permits (i.e., not operation permits) normally shall be valid for a period of 18 months; however, no construction permit shall be valid beyond the completion date of the experiment. The Virginia Department of Health shall establish the completion date of the experiment by determining when sampling on the 12 systems being monitored under this protocol will be completed. Upon successful completion of the experimental protocol, the Department will convert unused construction permits to conventional construction permits and extend the life of the permit to 18 months from the date of issuance. Such conversion shall be done at no cost to the permit holder. In the event that the system fails the experimental protocol, unused permits will not be renewed.

Permits shall note the experimental nature of the system (more detail on this to come from the Department) and that they cannot be converted to a certification letter. Upon successful completion of the experimental protocol, the holder of a valid experimental permit may convert the same to either a conventional construction permit or an approval letter. In the event that the experimental system fails to meet the protocol, the Department is not obligated to reissue either a construction permit or an approval letter.

- F. Aquarobic International Inc. shall be responsible for providing up to six classes for the VDH staff (up to 50 students each) during the first 12 months after this approval is granted and two classes annually thereafter. The training shall include a manual covering proper siting, sizing, construction, installation, and inspection processes for the Aquarobic Filter Bed system. All training materials, the course

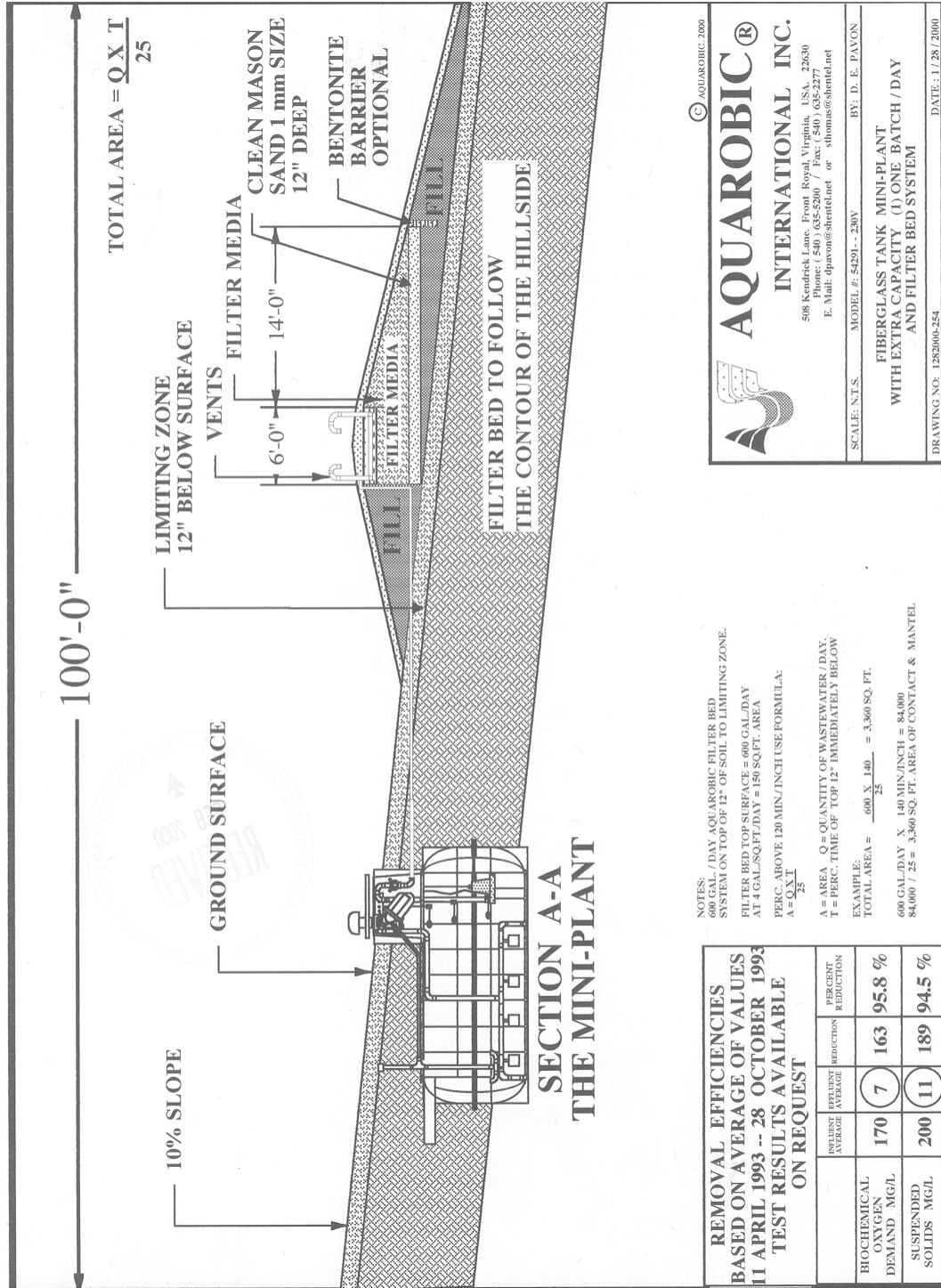
syllabus and training locations shall be reviewed and approved by the Division prior to the training.

- G. Aquarobic International Inc. shall be responsible for submitting information to the Division of Onsite Sewage and Water Services regarding system installation and monitoring results as indicated in Section VIII. The Department shall rescind this experimental protocol if Aquarobic International Inc. fails to report the necessary information in the specified time frame. Prior to taking such action the Department shall notify Aquarobic International Inc. of nature of the problem and the action the Department intends to take.
- H. Should the Aquarobic Filter Bed systems fail to perform to the satisfaction of the Department, the Department shall rescind or modify this experimental protocol. Prior to taking such action the Department shall notify Aquarobic International Inc. of the nature of the problem and the action the Department intends to take.



Figure 1:

Aquarobic Mini-Plant and Filter Bed System with Fill Material on Sloping Ground – Typical Drawing







### Details of the Filter Bed – Typical Drawing

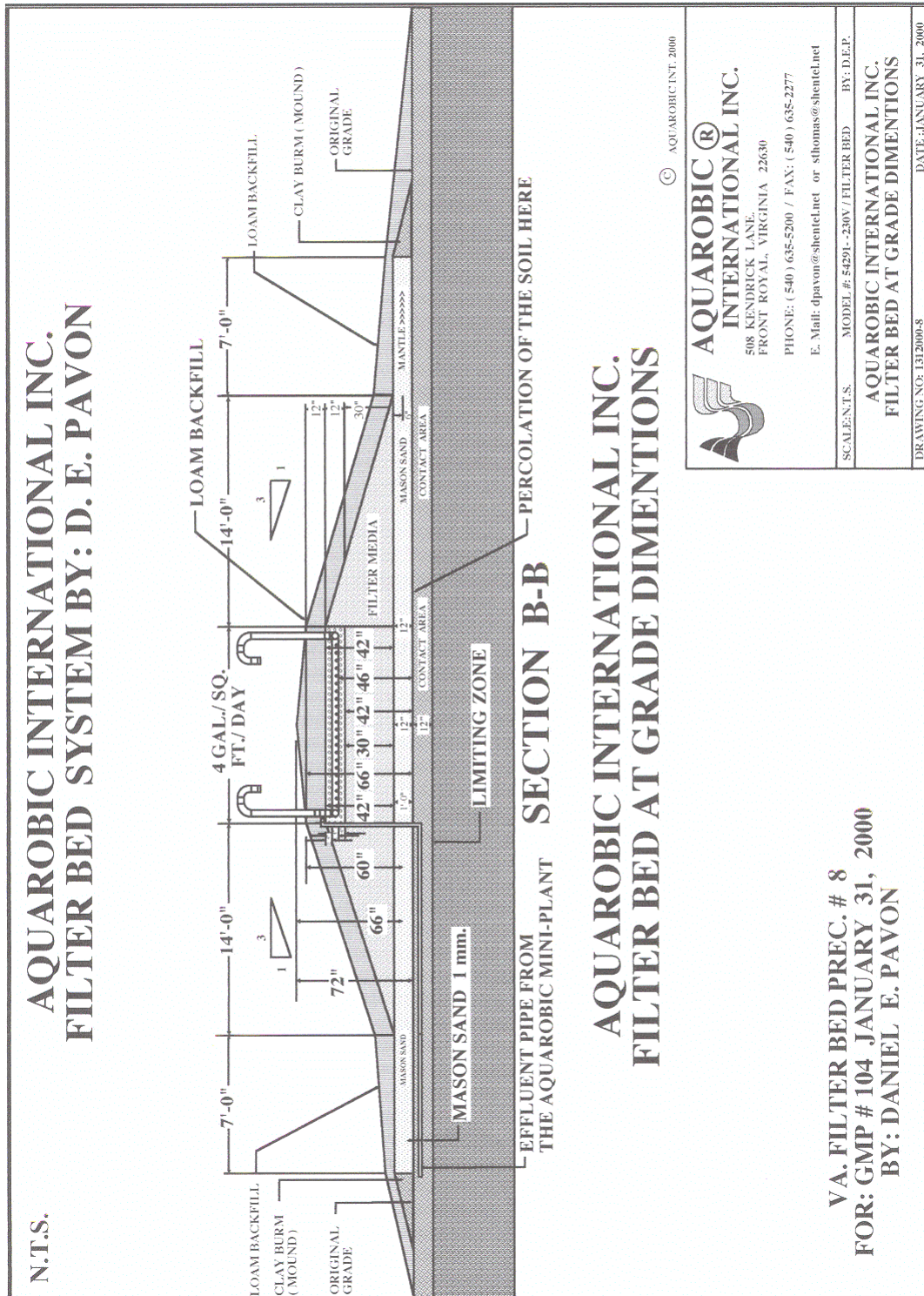
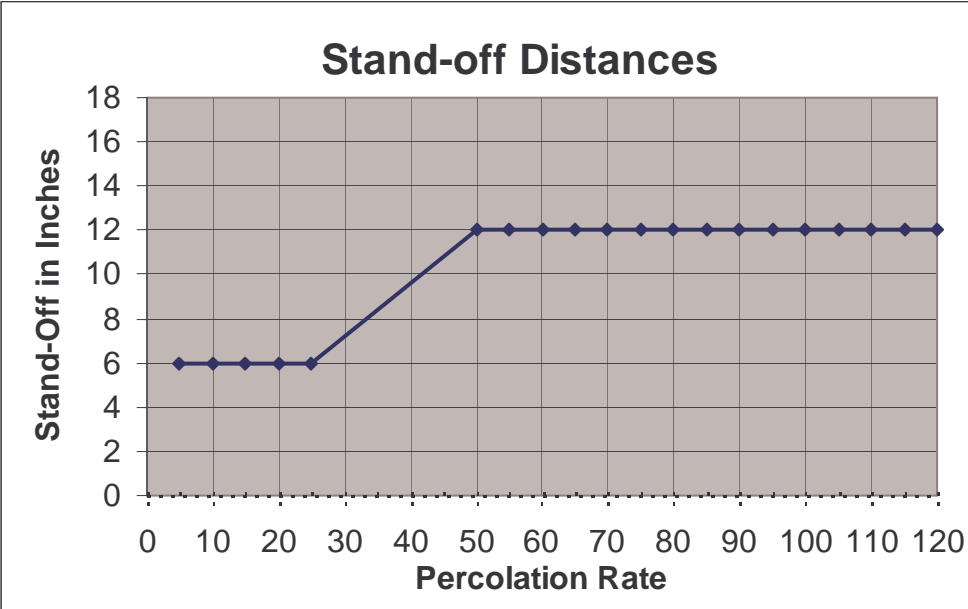


Figure 4:



Stand-Off Distance Required (Inches) from the Bottom of the Filter Bed to Limiting Zone (Gray Mottles or Bedrock) for the Aquarobic Filter Bed System.

Table 1:

## List of Proposed Mini-Plants and Rated Capacity

Model Number	Rated Capacity
54291-5-115V	500 GPD (Concrete Tank)
F54291-5-115V	500 GPD (Fiberglass Tank)
54291-6-230V	600 GPD (Concrete Tank)
F54291-6-230V	600 GPD (Fiberglass Tank)
54291-7.5-230V	750 GPD (Concrete Tank)
F54291-7.5-230V	750 GPD (Fiberglass Tank)
54291-8-230V	800 GPD (Concrete Tank)
F54291-8-230V	800 GPD (Fiberglass Tank)
54291-9 230V	900 GPD (Concrete Tank)
F54291-9 230V	900 GPD (Fiberglass Tank)
54291-10 230V	1,000 GPD (Concrete Tank)
F54291-10 230V	1,000 GPD (Fiberglass Tank)
54291-11 230V	1,100 GPD (Concrete Tank)
F54291-11 230V	1,100 GPD (Fiberglass Tank)
54291-12 230V	1,200 GPD (Concrete Tank)
F54291-12 230V	1,200 GPD (Fiberglass Tank)
54291-13 230V	1,300 GPD (Concrete Tank)
F54291-13 230V	1,300 GPD (Fiberglass Tank)
54291-14 230V	1,400 GPD (Concrete Tank)
F54291-14 230V	1,400 GPD (Fiberglass Tank)
54291-15 230V	1,500 GPD (Concrete Tank)
F54291-15 230V	1,500 GPD (Fiberglass Tank)
54291-20 230V	2,000 GPD (Concrete Tank)
F54291-20 230V	2,000 GPD (Fiberglass Tank)
54291-25 230V	2,500 GPD (Concrete Tank)
F54291-25 230V	2,500 GPD (Fiberglass Tank)
54291-30 230V	3,000 GPD (Concrete Tank)
F54291-30 230V	3,000 GPD (Fiberglass Tank)
54291-35 230V	3,500 GPD (Concrete Tank)
F54291-35 230V	3,500 GPD (Fiberglass Tank)
54291-40 230V	4,000 GPD (Concrete Tank)
F54291-40 230V	4,000 GPD (Fiberglass Tank)
54291-45 230V	4,500 GPD (Concrete Tank)
F54291-45 230V	4,500 GPD (Fiberglass Tank)
54291-50 230V	5,500 GPD (Concrete Tank)
F54291-50 230V	5,500 GPD (Fiberglass Tank)

Table 2: Total Area (Sq. Ft.) Needed for the Filter Bed

Perc Rate MPI	Design Flow GPD						
	300	450	600	750	800	900	1,000
5	400	400	400	400	400	400	400
10	400	400	400	400	400	400	400
15	400	400	400	450	480	540	600
20	400	400	480	600	640	720	800
25	400	450	600	750	800	900	1,000
30	400	540	720	900	960	1,080	1,200
35	420	630	840	1,050	1,120	1,260	1,400
40	480	720	960	1,200	1,280	1,440	1,600
45	540	810	1,080	1,350	1,440	1,620	1,800
50	600	900	1,200	1,500	1,600	1,800	2,000
55	660	990	1,320	1,650	1,760	1,980	2,200
60	720	1,080	1,440	1,800	1,920	2,160	2,400
65	780	1,170	1,560	1,950	2,080	2,340	2,600
70	840	1,260	1,680	2,100	2,240	2,520	2,800
75	900	1,350	1,800	2,250	2,400	2,700	3,000
80	960	1,440	1,920	2,400	2,560	2,880	3,200
85	1,020	1,530	2,040	2,550	2,720	3,060	3,400
90	1,080	1,620	2,160	2,700	2,880	3,240	3,600
95	1,140	1,710	2,280	2,850	3,040	3,420	3,800
100	1,200	1,800	2,400	3,000	3,200	3,600	4,000
105	1,260	1,890	2,520	3,150	3,360	3,780	4,200
110	1,320	1,980	2,640	3,300	3,520	3,960	4,400
115	1,380	2,070	2,760	3,450	3,680	4,140	4,600
120	1,440	2,160	2,880	3,600	3,840	4,320	4,800
130	1,560	2,340	3,120	3,900	4,160	4,680	5,200
140	1,680	2,520	3,360	4,200	4,480	5,040	5,600
150	1,800	2,700	3,600	4,500	4,800	5,400	6,000
160	1,920	2,880	3,840	4,800	5,120	5,760	6,400
170	2,040	3,060	4,080	5,100	5,440	6,120	6,800
180	2,160	3,240	4,320	5,400	5,760	6,480	7,200
190	2,280	3,420	4,560	5,700	6,080	6,840	7,600
200	2,400	3,600	4,800	6,000	6,400	7,200	8,000
210	2,520	3,780	5,040	6,300	6,720	7,560	8,400
220	2,640	3,960	5,280	6,600	7,040	7,920	8,800
230	2,760	4,140	5,520	6,900	7,360	8,280	9,200
240	2,880	4,320	5,760	7,200	7,680	8,640	9,600
250	3,000	4,500	6,000	7,500	8,000	9,000	10,000

NOTE: Aquarobic International, Inc. will prepare site specific design for flow rates > 1,000 GPD and/or Perc Rate > 250 MPI.

**Form-1**

**AQUAROBIC FILTER BED MATERIAL APPROVAL FORM**

DATE: \_\_\_\_\_

PROJECT ID: \_\_\_\_\_ VDH Permit #: \_\_\_\_\_

PROJECT LOCATION: \_\_\_\_\_

SYSTEM COMPONENT	MATERIAL SPECIFIED	MATERIAL USED
Backfill cover	Loam	
Effluent Grid Placement (12" depth)	Washed ½" to ¾" stone	
Filter Media (30" depth)	Effective size = 1 to 10 mm Uniformity coefficient < 5.0 Fine content < 0.5%	
Contact & Mantle Area (12" depth)	Sandy material; 0.5 to 1.5 mm sand; Mason Sand; Torpedo sand; or equivalent	
Fill Material used on a sloping ground to level the area (variable depth)	Material with soil texture group III or IV that may be impoted to the lot or dug-up from the lot.	

The list of material used in the filter bed system for this job meets the specifications and is acceptable to the Aquarobic International, Inc. for all the warranty purposes.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_ Name: \_\_\_\_\_

Position at Aquarobic International, Inc.: \_\_\_\_\_



Date: _____	Name: _____
VDH Permit #: _____	Date of Installation: _____
Installer: _____	
Design flow (GPD): _____	User: Residential                      Commercial
Mini-Plant™ Model #: _____	
Timer Settings Designed:	Aeration Start/Stop - _____
	Disposal Start/Stop - _____
Timer Settings Observed:	Aeration Start/Stop - _____
	Disposal Start/Stop - _____
Field Observation:	Odor _____
	Noise _____
	Ponding _____
	Breakout _____
	Tank _____
	Panel _____
User's Experience:	Odor _____
	Noise _____
	Alarm _____
	Backup _____
	Ponding/Seepage _____
	Power _____
Overall performance _____	



**Form-3**  
**Aquarobic Treatment Evaluation**

Sample Date: \_\_\_\_\_

Sample Collector: \_\_\_\_\_

VDH Permit #: \_\_\_\_\_

Date of System Start-Up: \_\_\_\_\_

Analysis Done By: \_\_\_\_\_ Flow GPD: \_\_\_\_\_

Results Approved By: \_\_\_\_\_

PARAMETER	UNIT	MLX(Opt.)	TRE	MTL
pH	s.u.			
Conductivity	mms			
Temperature	<sup>0</sup> F			
Dissolved Oxy.	mg/l			
BOD5	mg/l			
TSS	mg/l			
Chloride	mg/l			
Ammonia-N	mg/l			
TKN	mg/l			
Nitrate-N	mg/l			
Nitrite-N	mg/l			
Total-P	mg/l			
Fecal Coliform	CFU/ 100 ml			

NOTE: Sample      MLX = Mixed Liquor in the Mini-Plant™  
TRE = Treated Effluent from the Mini-Plant™  
MTL = Effluent Sample from the far end of the Mantle area  
(Indicate free water sample OR lysimeter sample)

Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_